

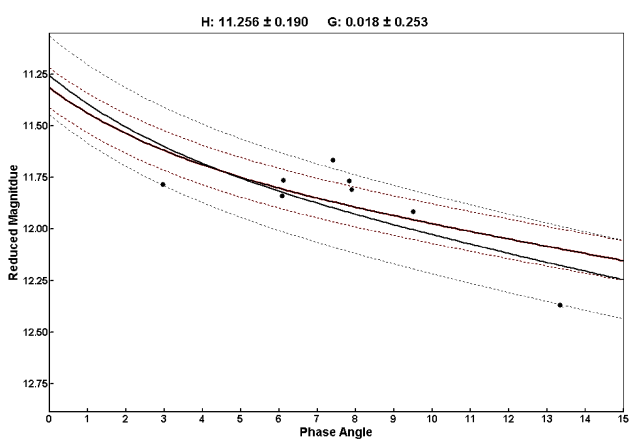
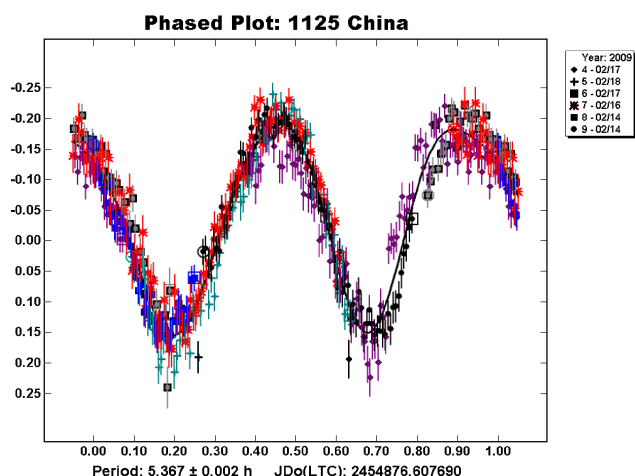
conversion to standard magnitudes. It is also indicative of the need to collect sufficient data points for small phase angles ($<7^\circ$).

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Reduced V magnitudes for 1125 China are plotted against phase angle to determine its absolute magnitude (H) and phase slope parameter. The red lines represent the solution and error envelope for $G = 0.15$. The black lines represent the free-floating solution of $G = 0.018$ and its error envelope.

LIGHTCURVES OF ASTEROIDS 358 APOLLONIA, 734 BENDA, AND 8356 WADHWA

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The rotation periods and lightcurve amplitudes for three asteroids have been determined by CCD differential photometry: 358 Apollonia, $P = 50.6 \pm 0.1$ h, $A = 0.15$ mag; 734 Benda, $P = 7.106 \pm 0.005$ h, $A = 0.3$ mag; and 8356 Wadhwa, $P = 3.04 \pm 0.01$ h, $A = 0.1$ mag.

This article reports on asteroid photometry studies conducted at Altimira Observatory during 2007 and 2008. Altimira Observatory is located in southern California. It is equipped with a 0.28-m Schmidt-Cassegrain telescope (Celestron NexStar-11) operating at F/6.3) and CCD imager (ST-8XE NABG) with Johnson-Cousins filters. Details of the equipment and instrument characterization are available at the observatory's website (http://www.geocities.com/oca_bob). CCD images were reduced in the standard way with bias, dark, and flat frames using *CCDSofT*. Asteroid brightness variations were determined by differential photometry, with an ensemble of 2 to 5 comparison stars in the same CCD field of view as the target asteroid, using the lightcurve analysis routines of *MPO Canopus*.

358 Apollonia. Wetterer et al. (1999) observed this object for one night. After finding a negligible change in brightness during a 7-hour observing run, they suggested that this asteroid has a long rotation period. This asteroid turned out to be a difficult target because its slow rotation is nearly synchronous with our diurnal cycle and its lightcurve amplitude is low. A total of 14 nights spanning 2 months (2008 Sept. and Oct.) were devoted to creating its lightcurve in V- and R-bands. The R-band lightcurve is shown in Figure 1. It displays a typical two-peak curve, with period $P = 50.6 \pm 0.1$ h and amplitude $A = 0.15$ mag. This is the first known report of a reliable rotation period and complete lightcurve for this asteroid. The V-band lightcurve (not shown) had the same period and shape as the R-band curve. There was no evidence of color variation as the asteroid rotates.

The determination of this lightcurve was greatly aided by a feature of *MPO Canopus*: the "comp star selector" that identifies candidate comp stars whose color indices are roughly comparable to typical asteroid colors, and provides their magnitudes on the standard system (B, V, R) to good accuracy (roughly ± 0.05 mag). This greatly simplifies the challenge of linking multiple nights (using different comp stars) to create an integrated lightcurve.

734 Benda. A total of 10 nights were devoted to this object, in order to take advantage of its near-zero phase angle in 2007 October to determine its phase curve. Most of these nights were adversely affected by unstable extinction conditions, so the following procedure was used. Each night, the imaging sequence was VV-RR-VV... Then, on a photometric night in 2007 December, each field of view from the "lightcurve" nights was imaged in the V and R bands (near culmination, typical air mass ≈ 1.1), and Landolt standard fields were taken at several air masses to determine the atmospheric extinction. This night provided a calibration of the comp stars in each field, which in

turn enabled determination of the asteroid's magnitude and color by reference to these now-calibrated comp stars.

The resulting lightcurve, shown in Figure 2, displays a rotation period of $P = 7.106 \pm 0.005$ h and $A = 0.3$ mag. This is consistent with the period $P = 7.11$ h reported by Behrend (2008). The asteroid's color is $(V-R) = 0.43 \pm 0.03$, and there is no evidence of color change with rotational phase. Benda's phase curve is shown in Figure 3. The best fit parameters are $H = 9.9 \pm 0.05$, $G = 0.10 \pm 0.05$. However, this value of the slope parameter is indistinguishable from the "default" value of $G = 0.15$, as illustrated in the figure. This is slightly fainter than the value $H = 9.7$, $G = 0.15$ reported by Tholen (2007).

8356 Wadhwa. This asteroid was observed on four consecutive nights in 2008 October. Unfiltered ("C" band) images were used for differential photometry of this faint object in order to get a signal-to-noise ratio of at least 100:1 in each image. The result, shown in Figure 4, is a low-amplitude double-peaked lightcurve displaying a rotation period of $P = 3.04 \pm 0.01$ h and $A = 0.1$ mag.

References

Behrend, R. (2008) Asteroid lightcurve data archive at: http://obswww.unige.ch/~behrend/page_cou.html

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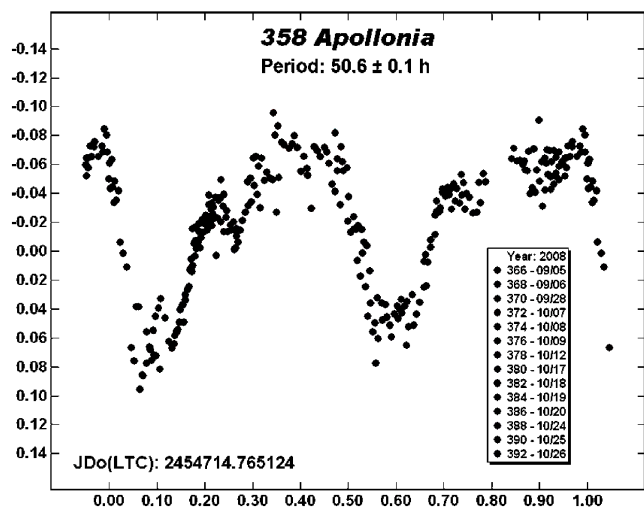


Figure 1: Lightcurve of 358 Apollonia, phased to $P = 50.6$ hours

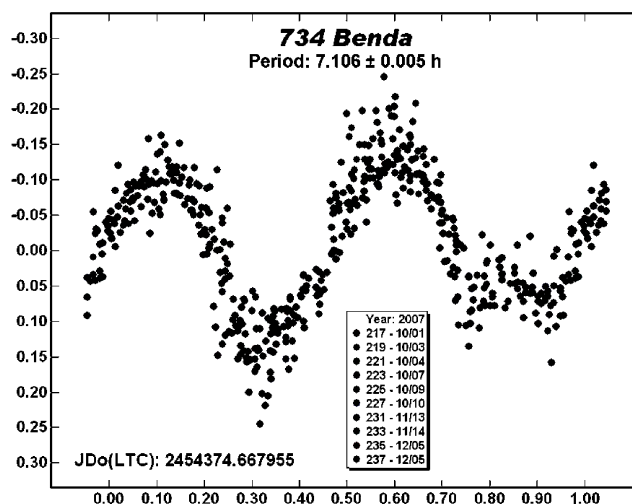


Figure 2: Lightcurve of 734 Benda, phased to $P = 7.106$ h.

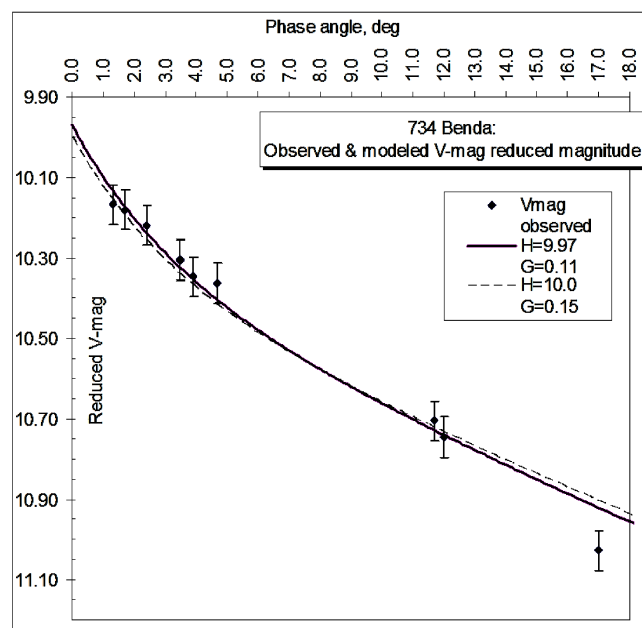


Figure 3: Phase curve of 734 Benda; 2007 October apparition.

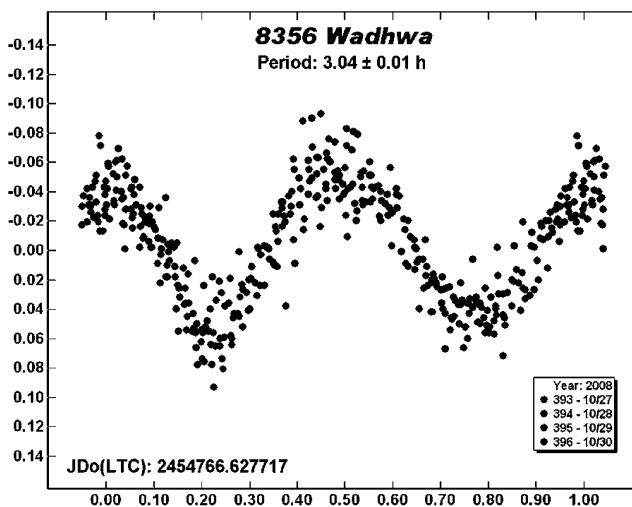


Figure 4: Lightcurve of 8356 Wadhwa, phased to $P = 3.04$ h.